REMARKS

Claims 1, 2, and 4-21 were presented for examination and were pending in this application. In the latest Office Action, claims 1, 2, 4-6, 8-12, 14, 15, and 17 were rejected, and claims 7, 13, 16, and 18-21 were objected to. With this amendment, claims 9 and 19 are amended, and new claim 22 is added. On the basis of the following remarks, consideration of this application and allowance of all pending claims are requested.

The claims recite a method for forming carbon nanotubes for an electron-emitting device, generally comprising granularizing a catalyst layer, soaking the granularized catalyst layer in a soaking gas, and then growing a plurality of carbon nanotubes by exposing the catalyst layer to a plasma source gas. As the specification explains, soaking the granularized catalyst layer in the soaking gas before growing the carbon enhances the diffusion properties of the granularized catalyst layer. Beneficially, this results in a more uniform and repeatable growth of the carbon nanotubes, producing nanotubes that have more uniform physical and electrical characteristics. (Specification, p. 12-13, 16.)

Claims 1, 2, 4-6, 8, 9, 14, 15, and 17 were rejected as anticipated by International Publication No. WO 01/94260 A1 to Resasco et al. Applicants respectfully assert that the claims are patentable over the cited art. Specifically, Resasco does not disclose or suggest, inter alia, the claimed pre-growth soaking step, the use of a plasma source gas to grow the carbon nanotubes, or granularizing a catalyst layer.

In the Office Action it was asserted that Resasco discloses the claimed soaking step. Specifically, the Office Action cited Resasco's specification at p. 24, lines 15-18, which describes a processing step in which a "reducing gas" is exposed to "catalytic particles" in a reaction cell. But this passage of Resasco does not disclose the claimed step of soaking the

granularized catalyst layer in a soaking gas, since Resasco's reducing of catalytic particles is not the same as the claimed soaking of a granularized catalyst layer. As Resasco explains on page 8, the reducing gas reduces the catalyst within the catalytic particles to prepare it for catalysis. Resasco does not disclose using a gas that enhances the diffusion properties of the granularized catalyst layer before the carbon nanotubes are grown. Resasco's reducing and the claimed soaking are two different steps that have different results and are performed in two entirely different contexts.

In the latest Office Action, the examiner acknowledged that "Resasco fails to explicitly state the recitation 'to enhance diffusion properties of the granularized catalyst layer.'" But the examiner then asserted that Resasco discloses the claimed soaking step inherently because Resasco discloses the same processing conditions. This assertion is factually incorrect; Resasco's processing conditions differ from those described in the present application in several respects.[1] For example, Resasco introduces the reducing gas "under high pressure" (Resasco, p. 8), whereas the disclosed pressure in the application is in a low pressure environment — up to 10 Torr, or 0.013 atmospheres (Specification, p. 16, 18). In fact, Resasco's reducing gas is used in a different context of a fundamentally different overall process. Resasco's process of carbon nanotube synthesis is thermal, while the plasma-enhanced chemical vapor deposition (PECVD) process disclosed in this application uses energy from a plasma source. Because the processes are different, Resasco's process chamber is nothing like the disclosed PECVD chamber. Finally, Resasco's reducing gas is exposed to a different thing: catalytically-impregnated pellets, not a

[1] The difference between the processing conditions disclosed in the present application and those disclosed in Resasco are noted only to demonstrate that Resasco's "reducing" step is not inherently the same as the claimed soaking step. These processing conditions are not themselves being relied on to show the novelty of claim 1, as claim 1 is novel over Resasco because it recites the soaking step.

catalyst layer. It is thus apparent that Resasco does not disclose the "same processing conditions" as those disclosed in the application. Because the Office Action fatally relies on this incorrect premise, Resasco does not inherently disclose a soaking step that enhances the diffusion properties of the granularized catalyst layer.

Resasco also fails to disclose "growing the plurality of carbon nanotubes by exposing the catalyst layer to a plasma source gas." As explained above, Resasco's method of growing single-walled carbon nanotubes is a thermal process in which the reaction occurs due to the kinetic energy resulting from elevated temperatures. This is contrasted with the claimed invention, where plasma energy from a plasma source gas provides the excitation for growing the carbon nanotubes. Using energy from a plasma source gas allows for significantly lower process temperatures when growing the carbon nanotubes than with the thermal process disclosed in Resasco. Because Resasco does not grow nanotubes using the energy from a plasma source gas, it is not surprising that Resasco fails to disclose any such plasma source gas. The passage cited in the Office Action (p. 25, line 10, through p. 26, line 3) does mention the use of certain hydrocarbon gases that are disclosed in the present application. But these gases are not plasma source gases in Resasco just because they have the same chemical formula as those in the application. As mentioned above, Resasco grows carbon nanotubes using a thermal process. There is no plasma source in Resasco because Resasco does not use a plasma-enhanced deposition process. There can thus be no plasma source gases in Resasco's process.

Lastly, Resasco does not disclose "granularizing a catalyst layer to generate nano-sized granules for growing a plurality of carbon nanotubes." In the claimed invention, a catalyst layer is granularized and then used to grow carbon nanotubes. In contrast, Resasco discloses "catalytically impregnated pellets," which comprise a solid support material impregnated with a

metallic catalyst, calcined, and then processed in a pellet form. Resasco's catalytically impregnated pellets are not a catalyst layer; therefore, Resasco does not disclose granularizing such a catalyst layer. In addition, because Resasco does not have a granularized catalyst layer, Resasco cannot disclose soaking a granularized catalyst layer in a soaking gas.

Based on at least these differences, claims 1, 2, 4-6, 8, 9, 14, 15, and 17 are novel and patentable over Resasco.

Claims 10-12 were rejected as made obvious by Resasco in view of U.S. Patent Publication No. 2004/0108515 to Muroyama et al. In this rejection, Resasco was applied to claims 10-12 in the same way as the reference was applied to claim 1. Therefore, claims 10-12 are patentable over the combination of Resasco and Muroyama for the same reasons provided above.

Claim 9 has been amended to address arguments made in the previous Office Action. Specifically, a portion of claim 9 was interpreted as an intended use limitation and was therefore given no patentable weight in the previous Office Action. Claim 9 has been amended preclude such an interpretation, clearly limiting the claimed additive gas to be one that improves the quality of the plurality of carbon nanotubes formed on the catalyst layer.

In addition, claim 19 has been amended to correct a typographical error in the units of the recited soaking gas density. No new matter has been added.

Lastly, new claim 22 has been added to recite specifically that the carbon nanotubes are grown on a substrate and are suitable for an electron-emitting device. As explained in a previous amendment, Resasco is directed to a completely different application for carbon nanotubes. Resasco describes a reaction cell for continuous catalytic production of carbon nanotubes, a process that simply would not be appropriate for growing carbon nanotubes for an electron-

emitting device. Whereas Resasco is concerned with growing single-walled carbon nanotubes using "catalytically impregnated pellets" in a reaction cell, the claimed invention involves growing carbon nanotubes on a catalyst layer to produce uniform carbon nanotubes that have mechanical and electrical characteristics suitable for an electron-emitting device. Resasco's technique would not be suitable for an electron-emitting device because Resasco's reaction chamber does not produce highly uniform, straight carbon nanotubes grown on a suitable cathode structure for an electron-emitting device.

Based on the foregoing, the application is in condition for allowance of all claims, and a Notice of Allowance is respectfully requested. If the examiner believes for any reason direct contact would help advance the prosecution of this case to allowance, the examiner is encouraged to telephone the undersigned at the number given below.

Respectfully submitted,
SUNG GU KANG, WOO KYUNG BAE, AND JUNG-JAE KIM

Dated: January 23, 2006

By: Robert A. Hulse

Robert A. Hulse, Reg. No. 48,473
Attorney for Applicant
Fenwick & West LLP
801 California Street
Mountain View, CA 94041
Tel.: (415) 875-2444
Fax: (415) 281-1350